
Three New Species of *Corydalis* (Fumariaceae) from Northwestern Sichuan, China

Xin-Fen Gao

Chengdu Institute of Biology, Chinese Academy of Sciences, Chengdu 610041, Sichuan, People's Republic of China. xfgao@cib.ac.cn

Yu-Lan Peng

Chengdu Institute of Biology, Chinese Academy of Sciences, Chengdu 610041, Sichuan, People's Republic of China, and Graduate University of the Chinese Academy of Sciences, Beijing 100049, People's Republic of China

Magnus Lidén

Botaniska trädgården, Uppsala Universitet, Villavägen 8, 75236 Uppsala, Sweden

Ying-Wei Wang

Beijing Institute of Botany, Chinese Academy of Sciences, Beijing 100093, People's Republic of China

ABSTRACT. The Jiuding Ridge (Sichuan, China) has been explored during the past several years by a team from Chengdu Institute of Biology, Chinese Academy of Sciences, and three undescribed species of *Corydalis* DC. (Fumariaceae) have been revealed and are apparently endemic to this mountain. The new species were observed in forest (*C. capitata* X. F. Gao, Lidén & Y. W. Wang), alpine scree (*C. acaea* X. F. Gao, Lidén & Y. W. Wang), and alpine rocky limestone areas (*C. schistostigma* X. F. Gao, Lidén, Y. W. Wang & Y. L. Peng). The two first species have their closest relatives in the Wolong-Balangshan District (Wenchuan, Sichuan). *Corydalis acaea* differs from *C. panda* Lidén & Y. W. Wang in its small size, few-flowered racemes, and broadly obtuse outer petals with low, short crests. *Corydalis capitata* differs from the *C. flexuosa* Franchet complex in the capitate racemes, small flowers with deeply serrate petals, and the peculiar, thin, strictly erect lateral branches. *Corydalis schistostigma* is unique in the *C. curviflora* Maximowicz ex Hemsley group, in the deeply cleft stigma and very forward-projecting crests to the inner petals, and possibly has its affinities more to the north and northwest in the Hengduan Mountains.

Key words: China, *Corydalis*, Fumariaceae, IUCN Red List, Sichuan.

Chaping Mountain, with an elevation of 4990 m at Jiuding peak, is located in northwestern Sichuan, China. It is the nearest mountain above 4000 m, close

to the Chengdu Plain. There are five natural reserves for protecting pandas and other wild animals in this mountain region. Because the main road runs along the Min River valley on the western side of the mountain and no roads reach the higher elevations, this area was neglected by botanists until 2002. During the past several years, Xin-Fen Gao and Yu-Lan Peng have explored the flora of this beautiful mountain. Among the botanical novelties are three new species of *Corydalis* DC. (Fumariaceae), which are described below. Magnus Lidén and Shengxiang Yu studied the species in the field in 2006, and one example has also been studied in cultivation.

1. *Corydalis acaea* X. F. Gao, Lidén, Y. W. Wang & Y. L. Peng, sp. nov. TYPE: China. Sichuan: Maoxian, Shiguxiang, alpine meadow, 3700 m, flowers pale blue, 20 July 2002, *Xin-Fen Gao, Yu-Lan Peng & Wei-Guo Tu 2517* (holotype, CDBI; isotype, CDBI). Figure 1.

Herba perennis glabra vel raro superne minutissime papillosa; rhizoma tenue breve verticale bulbo apicali tenui ovato; caules ramosi 2- ad 4-foliati ascendentes ad basin debiles; folia radicalia 2- ad 4-ternata foliolis profunde divisibilibus lobis parvis obovatis brevissime mucronatis; folia caulina radicalibus similia sed minora, petiolis brevioribus. Racemi breves, 3- ad 7-flori, in statu frugifero non vel parce elongati; bracteae inferiores (1- ad)2- ad 3-ternatae pedicellos subaequant lobis acutis, superiores minores parce divisae vel integrae; pedicelli erecti 7–10 mm longi. Sepala 1–2 mm longa; corolla azurea; petalum superum late

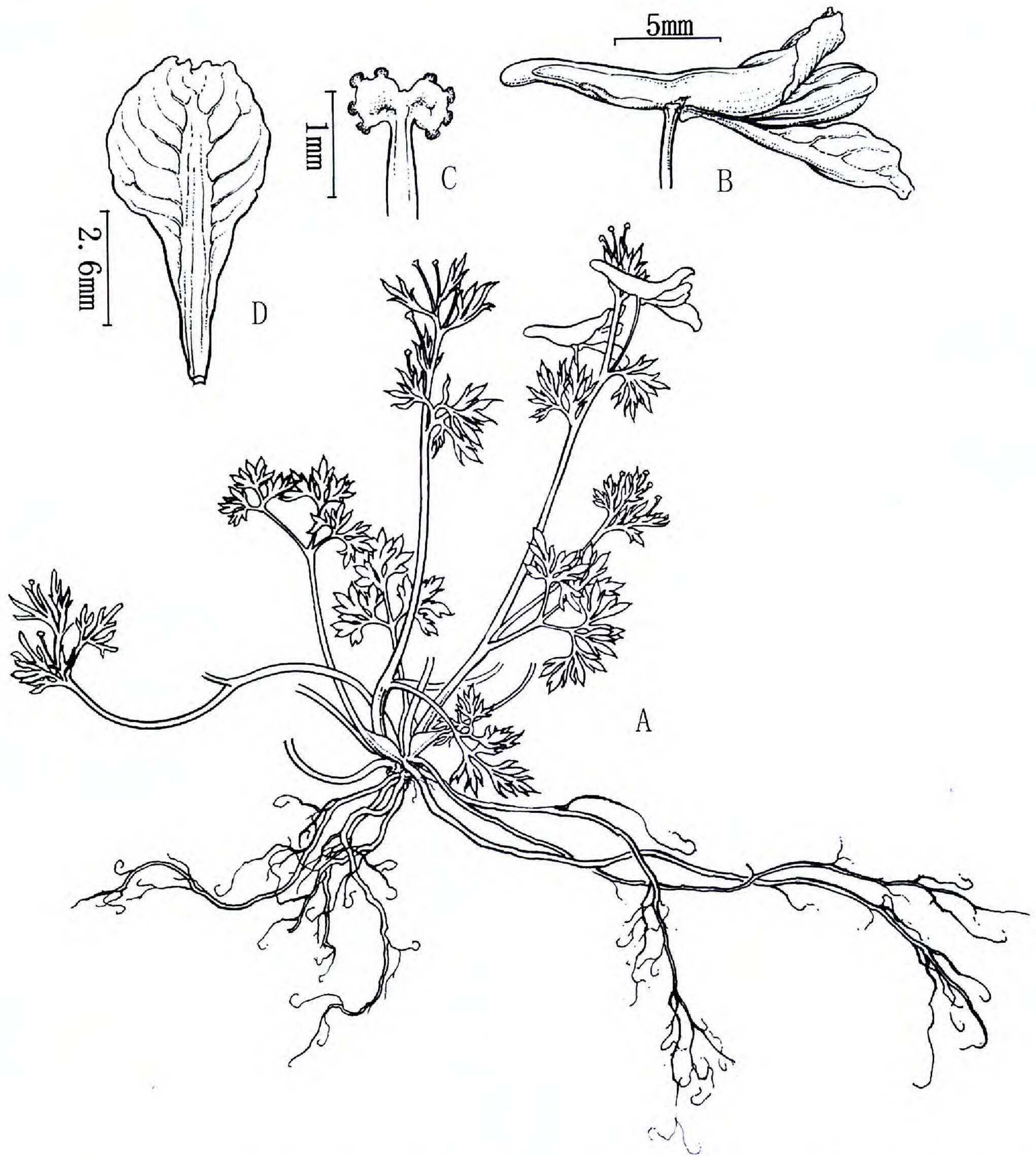


Figure 1. *Corydalis acaene* X. F. Gao, Lidén & Y. W. Wang. —A. Habit. —B. Flower. —C. Stigma. —D. Lower petal. Drawn by Jian Gu from the type specimen, *Gao et al.* 2517 (CDBI).

obtusum brevissime et angustissime cristatum crista apicem petali non attingenti, calcar leviter curvato; petalum inferum late obtusum basi marsupiatum; stigma divaricatum 8-papillatum. Capsula ex pedicello stricto pendula, anguste fusiformis, venis papillosis.

Herbs, perennial, glabrous; rhizome thin, short, vertical, with fleshy scales and a few remains of broad fleshy leaf bases, crowned by a leaf rosette from a narrowly ovate bulb, and emitting several long, thin, slightly fleshy pale roots, basal portion usually buried below scree or soil surface; stems few to several, thin, ascending, 5–16 cm, simple or often branched with 2 or 3(to 4) leaves, often suffused with brownish purple, especially the stems and undersides and apices of leaf lobes. Petioles of rosette leaves 2–10 cm, lamina 1–4

× 1–3 cm, 2- to 4-ternate with deeply lobed leaflets; the ultimate lobes narrowly obovate, shortly mucronate, 2–4 mm; primary leaflets long-stalked, secondary ones shorter; lamina often densely and finely papillose abaxially, especially along veins. Racemes short, 3- to 7-flowered, not or scarcely elongating in fruit; lower bracts (1)2- to 3-ternate, the upper ones smaller, less divided to entire, with acute lobes; pedicels thin, 7–10 mm, erect in fruit, smooth or finely papillose. Flowers pale to clear azure blue, sepals and veins sometimes with a purplish suffusion, the inner petals pale, but with the dorsal crests apically deeper blue, though usually white at the extreme apex, the purple blotch on the inner side of the inner petals tends to show through, especially in

herbarium specimens; sepals broadly triangular and deeply dentate to lanceolate and almost entire, 1–2 mm; outer petals with broad obtuse limbs, ecristate or usually with a shorter and narrower crest that does not reach the apex; upper petal with a slightly subsigmoidal curved, 9–10 mm spur into which a nectary protrudes ca. halfway or slightly more; inner petals 9–10 mm; the lower petal with a pouch or spurlet at the very base, abruptly widening into a 7-mm-wide, rounded limb; ovary with 12 to 16 ovules; stigma divaricate with 8 papillae. Capsule pendent from erect pedicels, narrowly fusiform, ca. 10 mm with 3 mm style, densely papillose along the veins, ca. 5- to 12-seeded.

Distribution and habitat. *Corydalis aeaee* occurs usually on scree, sometimes in alpine meadows at 3700–4100 m. It is found only in Sichuan Province, China.

IUCN Red List category. *Corydalis aeaee* is assessed as a taxon of Least Concern (LC) according to IUCN Red List criteria (IUCN, 2001).

Phenology. *Corydalis aeaee* flowers in late July to early September, fruits in late August to September.

Etymology. *Corydalis aeaee* is named after Aeaee, the island described in Greek mythology as the home of the sorceress Circe.

Discussion. The new species is placed in section *Elatae* and is similar to the recently described *Corydalis panda* Lidén & Y. W. Wang (Lidén, 2006), but it is a much smaller and more delicate plant with the leaves more divided, the outer petals comparatively much broader (to 7 mm) and obtuse to shallowly emarginate with shorter and narrower crests, the lower petal with a distinct pouch at the base, the nectary longer, the ovary papillose, and ovules more numerous (12 to 16).

Paratypes. CHINA. **Sichuan:** Maoxian, Fengyi Zhen, Jingzhou Cun, Dagou Zu, Sanjiaojia [31°39.25'N; 103°56.87'E], 3950 m, scree, 5 Aug. 2002, *Xin-Fen Gao, Yu-Lan Peng, Wei-Guo Tu 3257* (CDBI), scree, 4000 m, 30 July 2006, *Lidén & Shengxiang Yu 2006-10* (CDBI, PE, UPS); Shiguxiang, Chashankedu, Shilinsi, 3900 m, scree, 1 Aug. 2006, *Lidén & Shen-Xiang Yu 2006-18* (CDBI, PE, UPS).

2. *Corydalis capitata* X. F. Gao, Lidén, Y. W. Wang & Y. L. Peng, sp. nov. TYPE: China. Sichuan: Maoxian, Nanxin Zhen, Anxiang, Wucailing, 3000 m, 26 June 2003 [fl. & fr.], *Xin-Fen Gao, Yu-Lan Peng & Hui-Li Zhao 5353* (holotype, CDBI). Figure 2.

Herba perennis glabra; rhizoma breve squamis subcrassis imbricatis; caules erecti 4- ad 5-foliati superne ramosi, ramis tenuibus strictis erectis paucifoliatis. Folia radicalia parva

obtusotriangularia biternata foliolis profunde divisis lobis oblongis obtusis; folia caulina radicalibus similia breviter petiolata vel subsessilia. Racemi terminales densissime multiflori in statu fructifero elongati; racemi axillares pauciflori; bracteae petiolatae anguste obovatae lobis parvis paucis lateralibus praeditae praeter; bracteae infimae folia, suprema simulantes; pedicelli erecti tenues 7–12 mm longi, in fructu ad 20–30 mm elongati. Sepala albida ca. 2.5 × 2 mm ovata circumdentata; corolla purpurea; petala exteriora margine dentatum, crista lata acutissime dentata apicem petali conspicue superanti, calcari brevi; petala interiora pallida; stigma rotundatum 8-papillatum. Capsula lineari-oblonga ex pedicello stricto pendula 11- ad 18-sperma; semina parva nitida.

Herbs, perennial, glabrous, self-compatible; rhizome short, with a rather small hibernation bud, and a few coarse long linear roots; stems 1 to several, angular, erect, 35–75 cm, with only 4 or 5 leaves in the upper 1/2 or 2/3. Radical leaves small, like the cauline; cauline leaves shortly stalked (upper ones subsessile), bright green adaxially, glaucous abaxially, rounded-triangular in outline, biternate to subpinnate, with leaflets deeply cleft into oblong obtuse lobes. From the axils of the leaves, strict erect very thin flowering branches are produced, with few and tiny cauline leaves; terminal raceme with 10 to 25 flowers, very dense at anthesis, or perhaps with the basalmost flower more distant, the raceme elongating in fruit; racemes of axillary branches with fewer flowers; bracts narrowly obovate with 1 to 3 pairs of narrow lateral lobes, narrowed into a distinct stalk, 10–20 mm; lower bracts like the upper leaves; pedicels 7–12 mm in flower, elongating to 20–30 mm in fruit, straight and ± erect. Sepals rather large, ovate, margins dentate, ca. 2.5 × 2 mm, white; outer petals purple with broad short blue-purple crests that reach conspicuously beyond the apex of the petal and are sharply dentate, as are the rather wide margins of the limbs; spur comparatively short, ca. 8 mm, oblong, slightly curved, with robust nectary 2/3 as long; inner petals pale, 11–13 mm. Capsules pendent from erecto-patent pedicels, linearly oblong, ca. 11- to 18-seeded, to 20 mm with 2 mm style; seeds smooth, very small, ca. 1 mm.

Distribution and habitat. *Corydalis capitata* has been found only in a very restricted area above the villages Chashankedu and Anxiang from 3000–3300 m, in deep fertile soil in lush forests. It grows in sparse forest with some disturbance by yak, cow, and sheep.

IUCN Red List category. *Corydalis capitata* is assessed as a taxon of Least Concern (LC), according to IUCN Red List criteria (IUCN, 2001).

Phenology. *Corydalis capitata* flowers in June and early July and with the occasional late raceme into

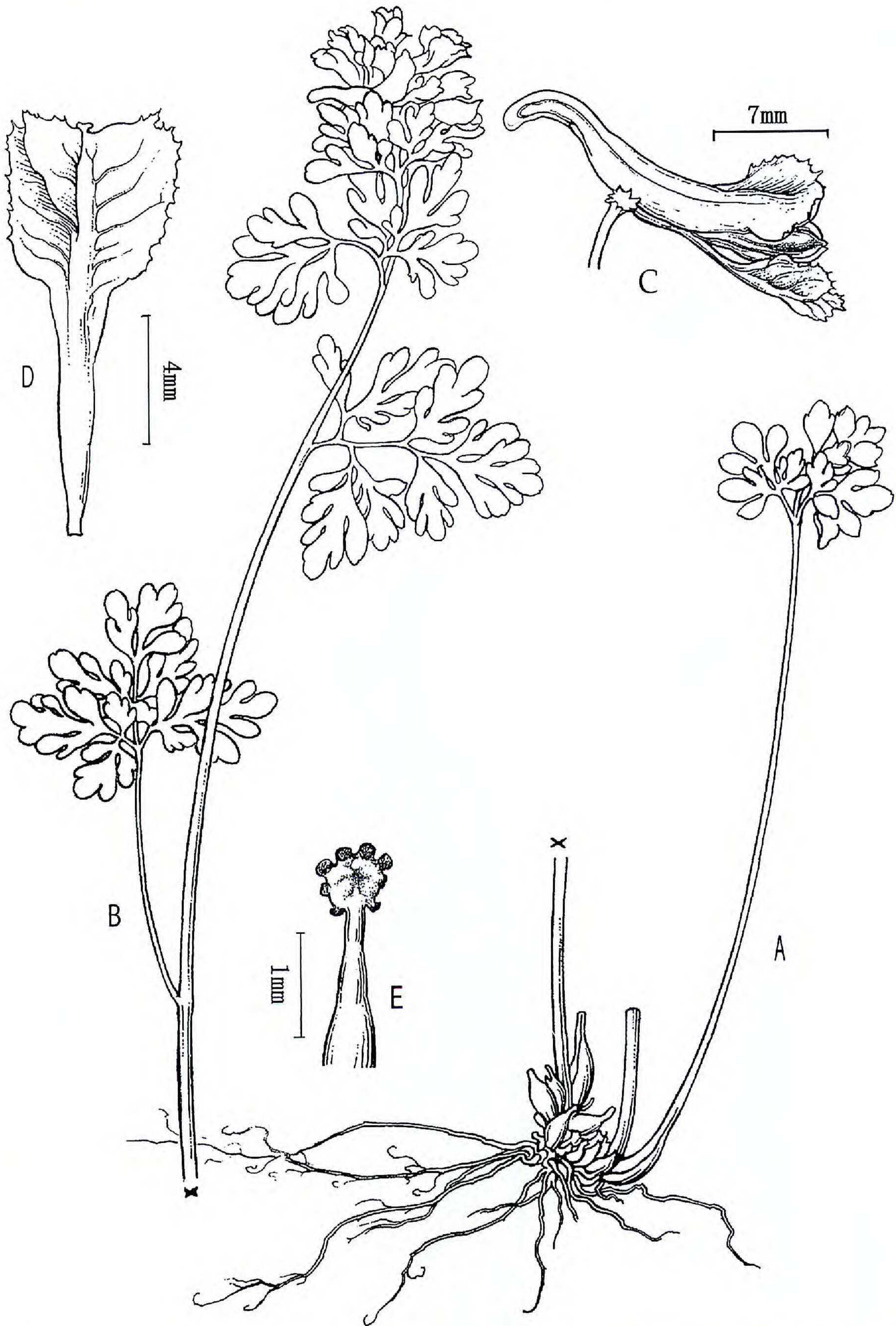


Figure 2. *Corydalis capitata* X. F. Gao, Lidén & Y. W. Wang. —A, B. Habit. —C. Flower. —D. Lower petal. —E. Stigma. Drawn by Jian Gu from the type specimen, *Gao et al.* 5353 (CDBI).

early August. It is unmistakable with its densely packed flower heads. In late autumn, when the stems wither, several fresh basal leaf rosettes are formed.

Etymology. The specific epithet refers to the head-like inflorescence (from the Latin “caput,” meaning “head”).

Discussion. *Corydalis capitata* has been sold through the Internet by the Chen Yi nursery in Beijing, and is presently in cultivation in Europe. The origin of these cultivars is unknown.

Corydalis capitata is placed in section *Elatae*; it is slightly similar to *C. calycosa* H. Chuang, but is easily distinguished by the very dense racemes, the smaller

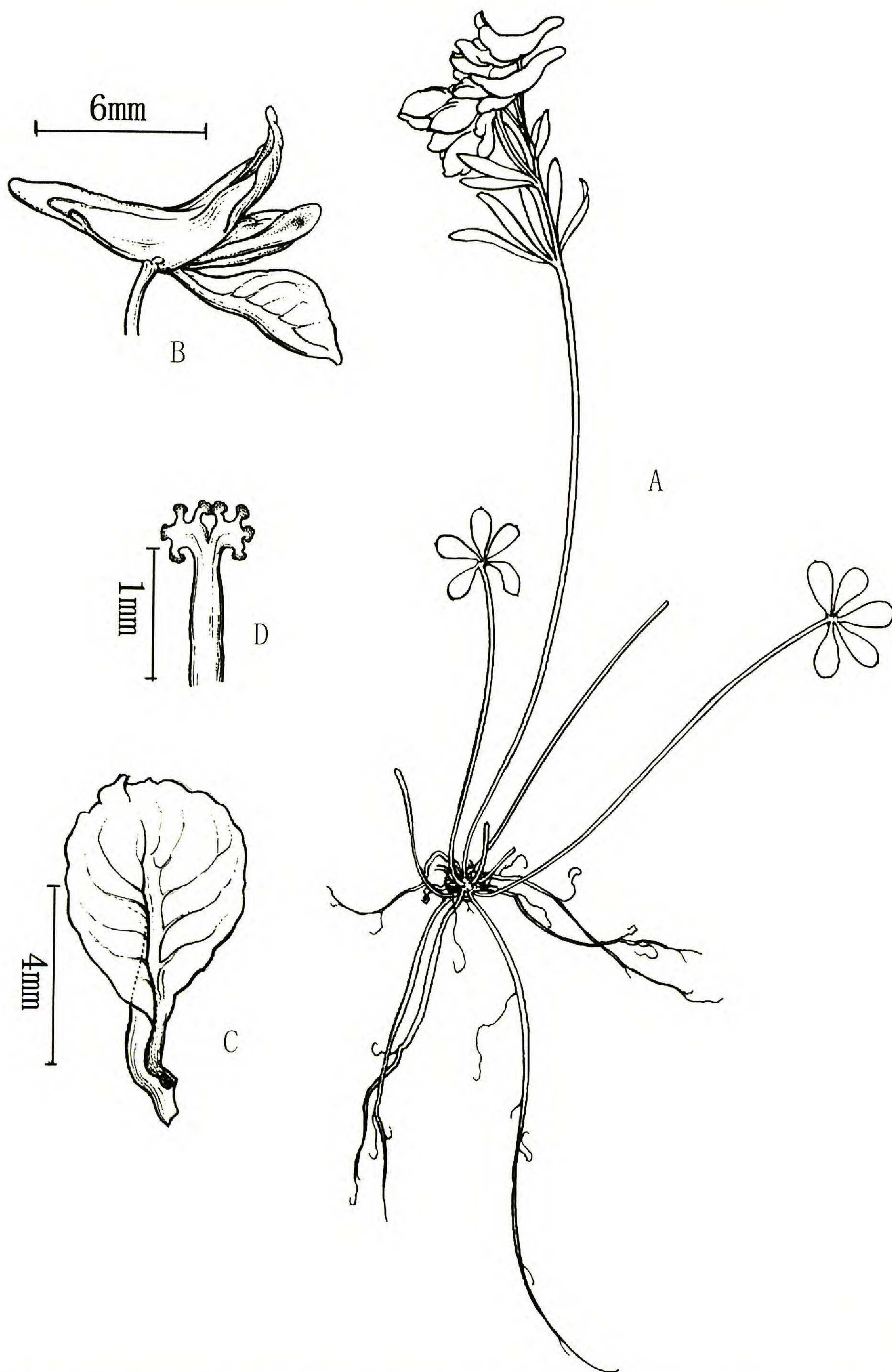


Figure 3. *Corydalis schistostigma* X. F. Gao, Lidén, Y. W. Wang & Y. L. Peng. —A. Habit. —B. Flower. —C. Lower petal. —D. Stigma. Drawn by Jian Gu from the type specimen, *Gao et al.* 2483 (CDBI).

purple flowers with sharply serrate crests and margins, the large sepals, and the peculiar thin erect lateral branches.

Paratypes. CHINA. **Sichuan:** Maoxian, Shiguxiang, Chashankedu, Doukoulinguan, 3180 m, 19 July 2002 [fr.],

Xin-Fen Gao, Yu-Lan Peng & Wei-Guo Tu 2409 (CDBI), 3320 m, 19 July 2002 [fl.], *Xin-Fen Gao, Yu-Lan Peng & Wei-Guo Tu* 2425 (CDBI), 1 Aug. 2006, *Lidén & Shen-Xiang Yu* 17 (PE, UPS). Unknown origin, cultivated from commercial source (UPS).

3. *Corydalis schistostigma* X. F. Gao, Lidén, Y. W. Wang & Y. L. Peng, sp. nov. TYPE: China. Sichuan: Maoxian, Shiguxiang, Chashankedu, Shilinsi, in sparse bushes, corolla bluish purple, 3575 m, 19 July 2002, *Xin-Fen Gao, Yu-Lan Peng & Wei-Guo Tu 2483* (CDBI). Figure 3.

Herba perennis glabra; rhizoma tenuissimum lineare, bulbo apicali tenuissimo ovato, radicibus penariis linearibus; caulis saepe solitarius tenuis erectus simplex uni- vel bifoliatus basi filiformis. Folia radicalia rotundata ternata vel quinata foliolis late obovatis, petiolis filiformibus; folia caulina sessilia in lobos 3 ad 5 anguste lanceolatos vel oblongos usque ad basin secta. Racemi breves, 3- ad 9-flori; bracteae integrae lanceolatae (bractea infima saepe profunde trifida) pedicellos erectos strictos tenues 10–15(–20) mm longos subaequantes vel eis breviores. Sepala minutissima; corolla caerulea vel cyanea, saepe partim purpureo-suffusa; petalum supernum latum subobtusum vix cristatum sursum curvatum, calcar substricto conico; cristae petalorum interiorum bene evolutae apices petalorum valde superantes; stigma profunde bifidum in quoque segmento 4-papillatum. Capsula ignota sed verisimiliter ex pedicello stricto pendula.

Herbs, perennial, glabrous; rhizome thin, terminating in a shortly stalked tiny bulb with a leaf rosette, and with scattered thin slightly fleshy pale linear storage roots; stems few, thin, erect, 8–20 cm tall, simple, with 1 or 2 leaves in the upper 1/3. Radical leaves with petioles 1–10 cm, lamina rounded, 10–15 mm wide with 3 to 5 obovate leaflets, dark green adaxially, glaucous abaxially, glabrous; cauline leaves sessile, cut to the base into 3 to 5 narrowly lanceolate lobes, 10–15(–20) mm. Racemes 3- to 9-flowered; bracts lanceolate, entire or the lowermost often divided; pedicels straight, thin, erect, 10–15(–20) mm. Sepals very small, 0.2–0.4 mm; corolla deep blue, with pinkish purple markings on keels of outer petals, sometimes with a pinkish suffusion toward the spur, sepals, and apex of inner petals (crest excepted), rarely pale blue; upper petal narrowly cristate, acute and curved upward at apex, with an 8–9 mm conical spur with nectary reaching more than halfway; lower petal with very short claw, gradually broadened into a broad rounded acuminate limb to 7 mm wide; inner petals 9 mm with very pronounced dorsal crests that protrude conspicuously beyond the junction of the inner petals; ovary with 14 to 16 ovules; stigma very deeply cleft, each half with 4 papillae, of which the basal ones show a tendency to be geminate. Fruit not known.

Distribution and habitat. *Corydalis schistostigma* can sometimes be found in grassland, but prefers more rocky habitats, usually on limestone, from 3500–3900 m. It is found only in Sichuan, China.

IUCN Red List category. *Corydalis schistostigma* is assessed as a taxon of Least Concern (LC), according to IUCN Red List criteria (IUCN, 2001).

Phenology. *Corydalis schistostigma* flowers in late July to August.

Etymology. The specific epithet refers to the deeply cleft stigma (from the Greek “schizein,” meaning “to cleave”).

Discussion. *Corydalis schistostigma* is placed in section *Fasciculatae* series *Curviflorae*. The most similar species to *C. schistostigma* is *C. shensiana* Lidén ex C. Y. Wu, H. Chuang & Z. Y. Su, which has more numerous and more divided leaves, 7- to 15-flowered racemes, more or less dentate outer petals, a short and obtuse spur, shorter nectary, white-tipped inner petals (concolorous in *C. schistostigma*), and stigma with prominent basal lobes. *Corydalis cytisi-flora* (Fedde) Lidén s.l., which is abundant in grasslands at the type locality, differs substantially from the new species in the broadly crested outer petals, numerous flowers, and stigma cleft up to half with rounded basal lobes (vs. stigma very deeply cleft without obvious basal lobes).

Paratypes. CHINA. **Sichuan:** Maoxian, Tumen Zhen, Guangming, Guolupengzi [31°39.289'N, 103°57.232'E], 3800–4000 m, meadow, 5 Aug. 2002, *Xin-Fen Gao, Yu-Lan Peng & Wei-Guo Tu 3147* (CDBI); Maoxian, Fengyi Zhen, Jingzhou Cun, Dagou Zu, Sanjiaojia [31°39.25'N, 103°56.87'E], 3800–3900 m, limestone, 30 July 2006, *M. Lidén 06-07, 13* (PE, UPS); Shiguxiang, Chashankedu, Shilinsi, 3500–3800 m, 1 Aug. 2006, *M. Lidén 06-20* (PE, UPS).

Acknowledgments. The authors were supported by the National Natural Science Foundation of China (grant 30470147). The 2006 field expedition by Magnus Lidén and Shengxiang Yu was supported by the National Science Foundation (project DEB-0614108). The authors thank two anonymous reviewers who helped improve the paper.

Literature Cited

- IUCN. 2001. IUCN Red List Categories and Criteria Version 3.1. Prepared by the IUCN Species Survival Commission. IUCN, Gland, Switzerland, and Cambridge, United Kingdom.
- Wang, Y. W. & M. Lidén. 2006. *Corydalis panda* (Fumariaceae), a new species from Sichuan, China. *Ann. Bot. Fennici* 43: 478–490.
- Wu, Z. Y., X. Zhuang & Z. Y. Su. 2006. *Corydalis*. Pp. 99–481 in C. Y. Wu (editor), *Flora Reipublicae Popularis Sinicae*, Vol. 32. Science Press, Beijing.